The EC16 is an advanced environmental chamber intended for automated test system and laboratory applications requiring fast temperature cycling and a large test volume. Standalone operation is supported by a full function keyboard with a 2 line, 16 character LCD display. The chamber temperature and the user temperature probe readings are normally displayed continuously. User programs are easily entered into the EC16 using a BASIC like command set programming language. In an automated test system, the EC16 functions as a remote data acquisition and control system using the capability of its expanded I/O architecture.

The electrically isolated user temperature probe allows for direct monitoring of critical temperatures on the device under test or certain areas inside the test chamber. As well as being displayed on the front panel, readings are accessible from the IEEE-488 or RS232/422 interfaces.

The EC16 command set, whether entered from the local keyboard or downloaded over the IEEE-488 or RS232/422 interfaces, provides for setting chamber temperature, temperature ramping rate and soak time at temperature, temperature deviation limits and temperature upper and lower limits.

Probe calibration procedures are built into the EC16 using local menu driven format. Special communication commands allow for communication to the analog I/O ports, the high speed serial port (SPI) and the parallel port. The chamber can be controlled remotely from the RS232/422 port or the IEEE-488 bus interface. When the IEEE-488 bus interface is used, transparent communication from the IEEE-488 bus to the RS232/422 port is supported. Programs and parameters are stored in battery-backed memory.

The PID coefficients used in the EC16 are user adjustable from the keyboard and remote interfaces. In addition, alarm function and sound level, BAUD rate, interrupt assignments and other communication port options are configurable from the front panel using an easy, menu driven format.

The EC16 supports several safety features including a mechanically adjustable over temperature thermostat, upper and lower software temperature limits, processor watchdog timer and open and short probe detection.

The EC16 is designed to be adaptable to your system application. If you have special requirements, call Sun Systems for solutions.
### GENERAL SPECIFICATIONS

#### MECHANICAL

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal Dimensions</td>
<td>(55.9 cm W x 55.9 cm H x 55.9 cm D)</td>
</tr>
<tr>
<td>Test Volume</td>
<td>(0.174 m³)</td>
</tr>
<tr>
<td>Overall Dimensions</td>
<td>(81.3 cm W x 74.9 cm H x 91.4 cm D)</td>
</tr>
<tr>
<td>Exterior Construction</td>
<td>Painted Aluminum Alloy</td>
</tr>
<tr>
<td>Door (see options)</td>
<td>Blank door supplied with chamber</td>
</tr>
<tr>
<td>Interior Construction</td>
<td>Stainless Steel, with exhaust port</td>
</tr>
<tr>
<td>Coolant Input</td>
<td>LCO₂, 37º male fitting, 1/4&quot; tube (optional) LN₂, 45º male fitting, 1/2&quot; tube</td>
</tr>
<tr>
<td>Exhaust</td>
<td>1/2&quot; NPT, male</td>
</tr>
<tr>
<td>Weight</td>
<td>(63 kg typical; 72 kg shipping)</td>
</tr>
</tbody>
</table>

#### PERFORMANCE

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set Temperature Range (LCO₂)</td>
<td>(-100ºF to +600ºF)</td>
</tr>
<tr>
<td>With LN₂ Option</td>
<td>(-300ºF to +600ºF)</td>
</tr>
<tr>
<td>Temperature Ramping Rate Range (Heating and Cooling)</td>
<td>(0.02ºF to ??ºF/min)</td>
</tr>
<tr>
<td>Number of Programmable Temperature Setpoints</td>
<td>Typically 100+</td>
</tr>
<tr>
<td>Time at Temperature Setpoint Range</td>
<td>1.0 sec to 99 hr, 59 min, 59 sec</td>
</tr>
<tr>
<td>Number of Programmable Set Times</td>
<td>Typically 100+</td>
</tr>
<tr>
<td>Air Circulation</td>
<td>600 CFM, vertical</td>
</tr>
<tr>
<td>Absolute Error Over Temp Range (not including probe error)</td>
<td>(±0.9ºF) to ±0.5ºC</td>
</tr>
<tr>
<td>Temperature Resolution (approx.)</td>
<td>(0.04ºF) to ±0.02ºC</td>
</tr>
<tr>
<td>Long Term Stability (per month)</td>
<td>(±0.4ºF) to ±0.2ºC</td>
</tr>
<tr>
<td>Line Voltage Sensitivity</td>
<td>(±0.2ºF) to ±0.1ºC for ±10% Line Voltage Change</td>
</tr>
<tr>
<td>Temperature Control Technique</td>
<td>Dual PID Algorithm, PWM</td>
</tr>
<tr>
<td>Ambient Temperature Operating Range</td>
<td>(32ºF to 122ºF)</td>
</tr>
<tr>
<td>Local Control</td>
<td>29 Key Keyboard (2 Line LCD Display)</td>
</tr>
<tr>
<td>Remote Control</td>
<td>RS232 / RS422 / IEEE-488 bus</td>
</tr>
<tr>
<td>IEEE-488 to RS232/RS422</td>
<td>Software/Bidirectional Transparent Operation</td>
</tr>
</tbody>
</table>

#### SAFETY

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Line Voltage Dropout</td>
<td>Program and Parameters Stored in Battery Backed Memory</td>
</tr>
<tr>
<td>Fail Safe</td>
<td>Open/Short Probe Detection, Watch-dog Timer, Software Temperature Limits, Over-temperature Thermostat</td>
</tr>
</tbody>
</table>

#### ELECTRICAL

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating Input</td>
<td>5600 Watts</td>
</tr>
<tr>
<td>Power Requirements</td>
<td>6000 Watts max, 220 VAC, 50/60 Hz, 1 phase</td>
</tr>
<tr>
<td>Optional</td>
<td>240 VAC (see Options)</td>
</tr>
</tbody>
</table>
LOCAL AND REMOTE CONTROL INTERFACES

The EC16 supports stand-alone operation with a full function keyboard, a 2-line LCD and a powerful programming language. For automated test systems, a complete talker/listener IEEE-488 interface is available with serial and parallel poll capability. For remote operation over long distances, RS232 and RS422 serial interfaces are provided. With few exceptions, the commands for the local keyboard and RS232/422 and IEEE-488 interfaces are identical.

FRONT PANEL

Application.........................................................................................................................EC16 Local Control
Operator Manual Program, Parameter Input................................................................................29 Key Keyboard
Operator Menu-Driven Visual Output.....................................................................................2 Line Alpha-numeric LCD
Visual Indicators................................................................................................Cool, Heat, Failsafe, Remote, Timeout,
Heat Enable, Cool Enable, Power
Audible Alarm..................................................................................................................User Programmable for Volume and Function

IEEE-488 BUS INTERFACE

Application..................................................................................................................EC16 Remote Control
Protocol.................................................................................................................Talker / Listener
Bus Address..................................................................................................................0-30, Set from Keyboard
Interrupt Capability........................................................................................................SRQ / Serial Poll and Parallel Poll

RS232 / RS422 SERIAL INTERFACE

Application..............................................................................................................EC16 Remote Control or
IEEE-488 Bi-directional Transparent Operation
Protocol.............................................................................................................ASCII Character Oriented
with Selectable XON/XOFF Protocol, Character ECHO, Parity
Data Rates........................................................................................................300-9600 BAUD
TEMPERATURE CHAMBER FEATURES

PID CONTROL

Optimum accuracy and stability in the test environment are ensured by the use of Proportional, Integral and Derivative (PID) control algorithms for both heating and cooling.

The PID coefficients define system response to the difference between set temperature and actual chamber temperature, the length of time that a difference in temperature may exist and the rate of change of the error temperature.

The default settings for the PID coefficients are generally suitable for most uses but, if necessary, each can be tailored to a particular application.

ZERO VOLTAGE SWITCHING

Control of power to the heaters and cooling solenoid is provided by zero voltage switching solid state relays to provide reliability and to reduce electrical noise.

SPECIAL FEATURES

Chart Recorder

Custom Fixturing
EXPANDED I/O ARCHITECTURE

The expanded I/O architecture provides for easy test fixture interfacing, strip chart recorder drive and additional sensor interfacing. Each interface is accessed by using the device IN and OUT commands.

ANALOG INPUT/OUTPUT INTERFACE

Input Channels......................................................................................................................4 Channel, 8 Bit A/D Converter
Applications.........................................................................................................................Analog Data Acquisition
Input Range................................................................................................................................0 to +5 VDC
(0 or 4 to 20 mA Input Jumper Selectable for Channel 0)
Input Leakage........................................................................................................................1 µA
Conversion Time....................................................................................................................26 µsec
Output Channels....................................................................................................................4 Channel, 8 Bit D/A Converter
Applications.........................................................................................................................Chart Recording and Analog Data Control
Output Ranges (Software Selectable)
- UniPolar Voltage...............................................................................................................0 to +5 VDC
- BiPolar Voltage..................................................................................................................-5 to +5 VDC
- Current (Channel 3 Only)..................................................................................................0 to 20 mA
Settling Time..........................................................................................................................10 µsec
Common Specifications
- Non-Linearity......................................................................................................................±1/2 LSB
- Absolute Accuracy.............................................................................................................±1 LSB
- Conversion Rate................................................................................................................I/O Limited
- Device Address...................................................................................................................DEV#4
- Connector.............................................................................................................................9 Pin D Type

USER PARALLEL PORT

Applications.........................................................................................................................Local Automated Switch and Test Accessories
Protocol................................................................................................................................16 Bit Address / 8 Bit Bi-Directional Data
Multiplexed, Byte Oriented
Interface Voltage....................................................................................................................TTL Levels
DC Supply Voltage Provided to User..................................................................................+12 VDC Unregulated
DC Supply Current (fuse protected)....................................................................................1.0 Amp max.
Device Address.....................................................................................................................DEV#1
Connector.............................................................................................................................26 Pin Flat Cable Header

HIGH SPEED SYNCHRONOUS SERIAL PORT

Applications.........................................................................................................................Distributed Processor Communication Link
Protocol..................................................................................................................................Byte Oriented, Master
Data Rate................................................................................................................................56K BAUD
Interface Voltage..................................................................................................................RS422 Levels
Device Address.....................................................................................................................DEV#2
Connector.............................................................................................................................9 Pin D Type

AUXILIARY I/O INTERFACE

Applications.........................................................................................................................Relay Drive
Protocol..................................................................................................................................Bit SET/RESET/SENSE
Interface Voltage..................................................................................................................High Current Open Collector Drive / TTL Sense
Device Address.....................................................................................................................DEV#4
Connector.............................................................................................................................Terminal Block or 26 Pin Flat Connector
(located internal to the unit)
**MENU-DRIVEN CONTROLLER SETUP (Front Panel)**

### CALIBRATION

- **[GREEN SHIFT] [CAL] [ENTER]**
  - Calibrate Probes? [Yes/No]
  - Calibrate Chamber Probe? [Yes/No]
  - [Selection of Probe Types, V or A]? [Yes/No]
  - [Temperature Set Points and Units]? [Yes/No] or [Value]
  - Calibrate User Probe? [Yes/No]
  - Modify Chamber Scale? [Yes/No]
  - Desired Scale? 1 = ºC, 2 = ºF, 3 = ºK
  - Modify User Scale? [Yes/No]

  Enter CAL Mode.
  
Enter YES if you really want to calibrate probes. Enter NO if you only desire to set units. Enter Access Code. (Set Access Code in Interrupts Menu.)
  
Enter YES to calibrate Chamber Probe. Enter NO to modify Chamber and User display units (ºC, °F, ºK).
  
  Select Probe type. Voltage or Current. If Probe selected, set 0ºC and 100ºC and select display units (ºC, °F, ºK).
  
  If Voltage or Current selected, set Inputs and Values.
  
  Repeat calibration procedure for User Probe.

  Enter YES to modify display units for Chamber Probe.
  
Enter preferred scale.

  Repeat selection procedure for User Probe display units.

### DEFAULT VALUES

- **[GREEN SHIFT] [SDEF] [ENTER]**
  - Set Up Defaults? [Yes/No]
  - GPIB Address? [0-30]
  - GPIB Lockup Time? [0, 2-59 sec]
  - Timeout Pre_Time? [0 to 59 sec]
  - Power Down Restart? [0-59 min]
  - D/A Output (A, B, C, D)? [Voltage Range]
  - Serial Port Mode? [RS232 or RS422]
  - RS Char Echo On? [Yes/No]
  - Baud Rate? [Required Baud Rate]
  - RS DTR-CTS On? [Yes/No]
  - BUZZ LP Timeout? [Yes/No]
  - BUZZ Single T.O.? [Yes/No]
  - INT LP Timeout? [Yes/No]
  - INT LP Done? [Yes/No]
  - INT Single T.O.? [Yes/No]
  - DEVIATION INT? [Yes/No]
  - CMD ERROR INT’S? [Yes/No]
  - BKPNT INTERRUPT? [Yes/No]
  - P_POLL{1-8} 0=NO
  
  Enter SET DEFAULT Mode.

  Enter YES if you really want to modify defaults.

  Enter GPIB Address.

  Enter GPIB Interface maximum lockup time (0 to disable).

  Enter GPIB SRQ or Serial Interface advanced interrupt generation before actual wait period timeout.

  Enables automatic restart of controller after set minutes.

  Select 0 to +5 V or -5 to +5V for channels A, B, C and D.

  Select Serial Port.

  Enter YES for serial port character echo.

  Select Baud rate from 300 to 9600 Baud.

  Enter YES for hardware handshake.

  Select buzzer volume.

  Set correct line frequency.

  Chart chamber temperature on D/A channel A. If YES, enter High/Low values.

  Chart user probe on D/A channel B. If YES, enter High/Low values.

  Enter YES to output PID control to D/A channel C.

  Enter YES to output PID control to D/A channel C.

  Enter tolerance at which controller detects that the temperature setpoint is reached.

  Enter YES to turn off cool enable when expectorant tank becomes empty.

### INTERRUPTS

- **[GREEN SHIFT] [SINT] [ENTER]**
  - Set up Interrupts? [Yes/No]
  - BUZZ LP Timeout? [Yes/No]
  - BUZZ Single T.O.? [Yes/No]
  - INT LP Timeout? [Yes/No]
  - INT LP Done? [Yes/No]
  - INT Single T.O.? [Yes/No]
  - DEVIATION INT? [Yes/No]
  - CMD ERROR INT’S? [Yes/No]
  - BKPNT INTERRUPT? [Yes/No]
  - P_POLL{1-8} 0=NO

  Enter SET INTERRUPT Mode.

  Enter YES if you really want to modify interrupts.

  Enter YES to enable BUZZER after each temperature segment timeout during local program execution.

  Enter YES to enable BUZZER when the end of a local program is encountered.

  Enter YES to enable Timeout Interrupts after each temperature segment timeout during local program execution.

  Enter YES to enable Single Temp. Timeout Interrupt at end of each temporary segment in single temp. mode.

  Enter YES to enable Deviation Interrupts.

  Enter YES to enable Command Error Interrupts.

  Enter YES to enable Breakpoint Interrupts.

  Enter 0 to disable Parallel Poll or 1 thru 8 to set bit position for Parallel Poll.

  The number that is entered will become the code that the CAL menu will expect to grant access. 0 to disable.
ENVIRONMENTAL CHAMBER

COMMAND SUMMARY
nn.n = Any fixed or floating point number
hh:mm:ss = Hours:Minutes:Seconds
[ ] = Optional
In = One of the ten global I variables

SINGLE COMMANDS

Segment Temperature
Read Current Chamber Temperature
Read Current Set Temperature
During Ramping
Read Current User Probe Value
Temperature Soak Period
Temperature Ramping Rate
Upper Temperature Limit
Lower Temperature Limit
Deviation Limit
Heating PID Adjust
Cooling PID Adjust
Pulse Width Modulation Adjust
Device I/O Commands
Time of Day
Read Units of Temperature
Controller Power On/Off
Heater Enable On/Off
Coolant Enable On/Off

SET
SET = nn.n [C, F, K]
(n/a)
(n/a)
(n/a)
WAIT = hh:mm:ss or WAIT = mm
or mmM or WAIT = Forever
RATE = nnn.n
UTL = nnn.n or nnnUTL
LTL = nnn.n
DEVL = nn.n TC01 DEVL
PIDH = nn.n, nn.n, nn.n
PIDC = nn.n, nn.n, nn.n
PWMP = nn
OUT (dev. no.):(addr.),(data)
TIME = hh:mm:ss
(n/a)
ON or OFF
HON or HOFF
CON or COFF

EXAMINE
TEMP? or C
CSET?
UCHAN?
WAIT? OR M
RATE?
UTL?
LTL?
DEVL?
PIDH?
PIDC?
PWMP?
IN (dev. no.):(addr.),In
TIME?
Scale#n? (n=1 or n=2)
(n/a)
(n/a)

PROGRAM COMMANDS

Execution Commands
STOP; RUNn; RUNn TIME=hh:mm:ss (Start RUN at Time of Day)
Edit Commands
EDITn; INS; DELL; DELPn; LISTn; STOREn
Control Commands
FOR In; NEXT In; GOSUBn; END
Debug Commands
BKPNTn
Standard Options

- 220 VAC, 50/60 Hz *
- 240 VAC, 50 Hz (International) *
- LCO₂, 850psi (hose supplied) *
- LCO₂, 300psi
- LN₂, 100psi
- LN₂, 25psi
- 3-Tank LCO₂ Manifold
- Ambient Air Blower
- Blank Door *

- Door with 1” Dia Access Port
- Door with 2” Dia Access Port
- Door with 1” Dia Port & 6” x 8” Window
- Door with 2” Dia Port & 6” x 8” Window
- Hinge Option for Door
- 1”, 2”, 3” or 4” Dia Left Side Access Port
- 2 Year Warranty *
- Custom Work §
- Fast Delivery

* no charge items
§ Due to the variety of applications, Sun Systems provides Custom Work per your specification.

Call Sun Systems for solutions to your custom temperature testing requirements.

(Data subject to change) © Sun Electronic Systems, Inc., December 1989

Accessories

Sun Systems can provide a wide variety of test system accessories in support of your temperature testing requirements. Blank doors and doors specifically modified for component temperature cycle testing are available along with switch matrix cards that can be tailored to your test fixture requirements. Extra LCO₂ and LN₂ hoses and fittings, equipment racks and temperature probes can be provided at your request.

We want to work with you.